The Effect of Healthy Food Affordability for Children Supported by WIC and/or SNAP

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Abstract

Aim 1: To define differences in food intake and body mass index (BMI) percentile between children ages who are beneficiaries in both, neither or either the Supplemental Nutrition Assistance Program (SNAP) or the Special Supplemental Nutrition Program for Women, Infants and Children (WIC).

Aim 2: To quantify the effect of healthy food affordability on food intake and BMI percentile among WIC and SNAP beneficiaries, ages two to four years old.

Introduction: Obesity is a serious problem for children in the US. In prior studies, SNAP and WIC usage have not been found to correlate to obesity. However, children supported by SNAP have been shown to have poor diets. Many parents supported by WIC and/or SNAP report cost being a barrier to access of healthy foods.

Methods: We used data from NHANES, on children ages 2-4 from 2003-2010. After exclusion of participants with missing variables, the sample population was n=1714.

Results: WIC use, but not SNAP use, was associated with higher carbohydrate (242 g 95% CI: 221, 262) and sugar (133 g 95% CI: 121, 145) intake as compared to children supported by neither WIC nor SNAP [carbohydrates (208 g 95% CI: 195, 221) and sugar (112 g 95% CI: 105, 119)]. WIC and SNAP was not associated with obesity. WIC and/or SNAP use was associated with less healthy food affordability. However, healthy food affordability was not associated with overnutrition or obesity.

Discussion: A longitudinal study is needed to examine effects of WIC participation on overnutrition. Healthy food affordability was not found to be a risk factor for obesity and overnutrition. Further studies are needed to determine the risk factors for overnutrition and obesity among WIC and/or SNAP participants to inform future interventions.

Chapter 1: Specific Aims

Although designed to promote health, research shows that participation in the Supplemental Nutrition Assistance Program (SNAP) correlates with unhealthy diets for children.[1] In contrast, the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) has been shown to have a beneficial effect.[2] The federal government uses SNAP and WIC to target food insecurity; however, childhood overnutrition and obesity are also serious epidemics in this country. SNAP may not provide enough support to make fruits and vegetables affordable for participants and thus they may have a greater intake of cheaper and often unhealthy foods compared to non beneficiaries. These poor eating habits may track from childhood into adulthood leading to obesity and negative health outcomes. Public health programs need to address childhood overnutrition among SNAP participants for this program to be successful in promoting health. The primary objective of this study was to determine if perceived ability to afford healthy foods is a risk factor for overnutriton and obesity for WIC/SNAP participants compared to non-participants. If affordability of healthy foods was correlated with the poor diet among WIC and/or SNAP participants then intervention programs can be designed around healthy food affordability. We also compared SNAP to WIC to detect any differences between the two programs in dietary consumption and BMI. We used the 2003-2010 National Health and Nutrition Examination Survey (NHANES) to examine our 2 specific aims.

<u>Aim 1</u>: To quantify differences in intake and body mass index (BMI) percentile between WIC and/or SNAP beneficiaries and non-beneficiaries, ages two to four years old

We hypothesize that SNAP is associated with higher intakes of energy dense, and low nutrient foods and higher BMI percentiles compared to non-participants, and WIC would have the opposite associations.

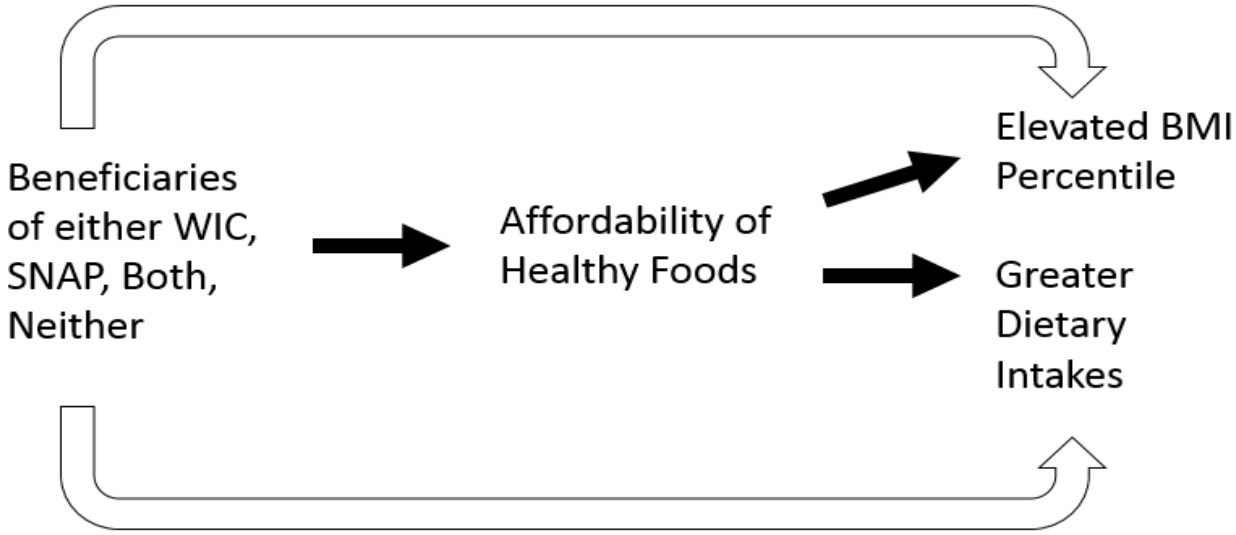
<u>Aim 2</u>: To estimate the effect of perceived healthy food affordability on dietary intake and BMI percentile among WIC and/or SNAP beneficiaries and non-beneficiaries, ages two to four years old

2a: To examine the relationship between WIC/SNAP status and healthy food affordability. We hypothesized that WIC and/or SNAP participation was associated with lower perceived healthy food affordability compared to children not on either program.

2b: Examined the relationship between healthy food affordability and obesity. We hypothesized that less healthy food affordability was correlated with greater BMI percentile.

2c: Examined the relationship between health food affordability and diet consumption. We hypothesized that less healthy food affordability was correlated with greater intake of various dietary measures (calories, fat, carbohydrates, protein, saturated fat, sugar).

Aims Conceptual Diagram (Aim 1 is the hollow arrows, Aim 2 is the solid arrows)



Chapter 2: Introduction

SNAP, formerly the food stamps program, and WIC are the two largest federal grocery subsidy programs in the United States.[3,4] SNAP and WIC provide funds to low income households, based on annual household income with state specific requirements with a maximum ranging between 100% to 185% of the Federal Poverty Limit.[3,4] The value of benefits given to participants varies based on need and available funds.[3,4] The eligibility requirements differ for WIC and SNAP.[3,4] WIC supports pregnant, postpartum, or breast feeding women and children until their fifth birthday; SNAP includes all age ranges.[3,4] SNAP benefits can be used on any food intended to be eaten in the home or seeds to grow food.[3] Given this broader benefits definition, SNAP participants are able to purchase foods that are calorie dense and nutrient poor using their federal subsidies.[3] WIC is more restrictive and eligible items for children ages one to four are: juice, milk, mostly whole grain cereal, eggs, fruits, vegetables, whole wheat bread, canned fish, legumes and peanut butter.[4] WIC also includes nutrition advice at WIC clinics and referrals to other health professionals and social services.[4]

A significant portion of the United States population is enrolled in either WIC or SNAP.[5,7] In 2013, 4.6 million children (ages one to four years old) were enrolled in the WIC.[5] Approximately 58.2% of WIC participants are White, followed by 19.8% African-American and 12.2% American Indian or Alaskan native;[6] 41.5% of WIC participants are Hispanic.[6] In June 2014, 46.5 million Americans participated in SNAP with 49% of participants being children under the age of 18.[7] Approximately 43% of SNAP participants are White, while 33% are African-American and 19% are Hispanic.[7]

Both WIC and SNAP have shown success in lowering food insecurity.[8,9] Perez-Escamilla et al. (2000) examined preschoolers in Hartford, Connecticut using the Radimer/Cornell hunger scale and found that food stamps reduced food insecurity (OR: 0.10; 95% CI: 0.02-0.56).[8] Metallinos-Kataras et al. examined families in Massachusetts WIC program with a Longitudinal study from 2001-2006 and found that food insecurity without hunger was reduced by an additional WIC clinic visit (OR: 0.92; 95% CI: 0.90-0.94) and food insecurity with hunger was reduced by an additional clinic visit (OR: 0.94; 95% CI: 0.89-0.98).[9] However, some food insecurity remains for those on WIC or SNAP.[8,9] Measures of food insecurity include assessment of balanced diet but are more heavily weighted toward caloric deficiency.[8.9]

Despite some success, families participating in government assistance grocery programs still claim that cost is limiting food purchases.[10,11] This cost barrier applies more towards fresh fruits and vegetables.[10,11] Families unable to afford healthier foods are forced to rely on low cost food options.[10,11] DeMartini et al. performed a cross-sectional survey of families (93% of which participated in federal grocery programs) at a clinic in Cincinnati found 33.2% of the population to be food insecure and those who were food insecure reported that “healthy food choices in my community are not affordable” (P=0.01).[10] Haynes-Maslow et al. set up focus groups of low income individuals, most of which use federal grocery subsidies, in Durham and Orange Counties in North Carolina and cost was cited 4 times more than any other barrier as a reason for low fruit and vegetable intake.[11]

The resulting diet quality of WIC and SNAP participants varies.[1,2] Children supported by SNAP were shown to eat less healthy compared to low income non-

participants, while this trend was not found with WIC.[1,2] Leung et al. examined low SES children between the ages of 4-19 in NHANES 1999-2008 using 24-hour dietary recalls and found that SNAP participants consumed more sugar-sweetened beverages (% increase: 44%; 95% CI: 9%-89%), more high fat dairy (% increase: 47%; 95% CI: 7%-101%), more processed meats (% increase: 44%; 95% CI: 9%-91%) and less nuts, seeds and legumes (% decrease: 19%; 95% CI: -35% to 0%), as compared to individuals not participating in the program.[1] Siega-Riz et al. used USDA CSFII surveys from years 1994 to 1996 and 1998 to show that WIC has a beneficial effect on preschooler's intake of energy from fat (p=0.02), carbohydrates (p=0.03), added sugar (p=0.03), and fruit and vegetables (p=0.03).[2] Despite a more energy dense diet, childhood SNAP participation was not strongly associated with obesity among children.[1] Leung et al. found the odds of a SNAP participant being obese were 1.11 (95% CI: 0.71-1.74) times higher than for non-participants.[1]

Obesity is the most common form of malnutrition among children in the United States.[12] Childhood obesity needs to be studied so its growth can be slowed and reversed.[12] Childhood obesity among children age two to five grew from 5.0% in 1971-1974 NHANES to 12.1% in 2009-2010 NHANES.[12]

To our knowledge this study is the first to examine if affordability of healthy foods is correlated with poor dietary intake or obesity among child WIC and/or SNAP participants.

Chapter 3: Methods

We used data from NHANES, a nationally representative survey designed to assess the health and nutrition status of adults and children in the United States.[13] NHANES has two year survey cycles for data collection.[13] The National Center for Health Statistics releases data with all personal indicators removed as public use data sets.[13] NHANES oversamples certain groups (African Americans, Mexican Americans, low-income White Americans, adolescents, and the elderly) to increase the precision and reliability of these subgroups that are often of particular interest.[14]

We used data from the demographics survey, dietary survey, food security surveys, and body measures from clinic-based examination. It must be noted that questions were answered not by the children themselves but by an adult in their household with enough knowledge about the child to answer the questions.

We created research variables for WIC/SNAP status, healthy food affordability, and BMI percentile. We assessed WIC or SNAP participation by an answer of “yes” to receiving benefits in the last 12 months. WIC participation was assessed with the question “did [your child] receive benefits from WIC, that is, the Women, Infants and Children program, in the past 12 months?” SNAP participation was assessed with the question “in the last 12 months, did [you or any member of your household] receive food stamp benefits?” We classified families into mutually-exclusive categories of both WIC and SNAP, WIC only, SNAP only, or neither. We categorized families as lacking access to healthy foods if they answered “often” or “sometimes” to either of two statements. The statements were “[I] relied on only a few kinds of low-cost food to feed the [child] because [I was] running out of money to buy food” and “[I] couldn’t feed [child] a

balanced meal, because [I] couldn't afford that." NHANES health professionals measured weight using a digital scales to the nearest tenth of a kilogram of children wearing gowns without shoes.[15] NHANES health professionals measured height using a stadiometer to the nearest tenth of a centimeter of children without shoes.[15] We calculated BMI percentile using the CDC's SAS program using gender, age, height, and weight. BMI for age percentiles were based on 2000 CDC growth curves.

NHANES data collectors measured diet with a 24 hour dietary recall through an adult proxy for the child.[16] Nutrient intake variables are calculated by NHANES using a complex method to approximate the nutrient content of food items listed in recall data. The data measures examined in this study are total energy (kcal), proteins (g), carbohydrates (g), total fat (g), total saturated fatty acids (g) and total sugars (g). These dietary intake variables would help examine overnutrition among the children.

Only children between the ages of two to four were included in the analysis because WIC eligibility ends at age five and after age two height becomes consistently measured with a stadiometer. NHANES data from the years 2003-2010 were used in this study, pooling 4 survey cycles with per-year samples ranging from 10,122 to 10,537 subjects for a total sample population of 41,156 subjects. However only 3,040 were between two and four years of age. Subjects were excluded if: they were missing questions for healthy food affordability (n=188); SNAP usage (n=825); WIC usage (n=2); BMI percentile (n=145); or dietary recall (n=166). The analytic sample population was 1714 two to four year olds.

We used SAS 9.3 software® for all statistical analysis. All analysis was weighted based on NHANES weights to make the results nationally representative by correcting for oversampling.

Covariates were assessed using standard questionnaires administered by professional data collectors.[13] We tested each covariate for the potential to confound effect estimates of interest. Specifically, if an effect estimate controlled for a covariate differed by 10% from a crude effect estimate, then that covariate was considered a confounder and included in multivariate-adjusted regression models. Age in months, gender, race/ethnicity, household size and highest household education were tested for confounding in every model. Other covariates were only assessed for confounding in certain situations. For example, when assessing the correlation between healthy food affordability and outcomes, we controlled for WIC/SNAP status to show that affordability led to negative health outcomes independent of WIC/SNAP status. When a test involved a diet measure, we controlled for the day of the week on which diet was measured. We did not assess income as a confounder when the test involved affordability because it is on the causal pathway. We used a 0.05 significance level for statistical testing.

Specific Aim 1 Analysis

We examined differences in dietary intake and BMI percentile by WIC/SNAP status in two to four year-olds. Linear regression analysis compared the four WIC/SNAP categories using “ProcSurveyReg” and “LSMeans” option in SAS. This analysis calculated an adjusted mean and confidence interval for BMI percentile and dietary

measures outcomes for each WIC/SNAP status category, allowing us to compare the different groups to each other, controlling for confounders and accounting for the complex survey design of NHANES.

Specific Aim 2 Analysis

We examined the effect of healthy food affordability on dietary intake and BMI percentile by WIC/SNAP status of two to four year-olds. First, we attempted to show the association between WIC/SNAP status and healthy food affordability. We used "ProcSurveyLogistic" to determine the adjusted odds ratio and confidence interval for healthy food affordability by WIC/SNAP status using non-beneficiaries as the referent group. Second, we compared healthy food affordability to BMI percentile and dietary intake using "ProcSurveyReg" with the "LSMeans" option to compute adjusted means and confidence intervals for BMI percentiles and diet measure outcomes stratified by healthy food affordability status. A significant correlation between WIC and/or SNAP and lower healthy food affordability and lower healthy food affordability and either higher BMI or greater dietary intake, would have supported a conclusion that healthy food affordability is significant risk factor for negative outcomes of children participating in WIC and or SNAP.

Chapter 4: Results

General

Table 1 shows the demographics of the sample population. The majority (58.5%) of the children received some type of government food assistance (29.2% WIC and SNAP, 14.5% WIC only, and 14.8% SNAP only). Children supported by both WIC and SNAP were spread evenly among Mexican-American (27.1%), non-Hispanic White (29.3%), and non-Hispanic Black (25.4%). Children supported by WIC only were mostly Mexican American (34.7%) and non-Hispanic White (43.6%). Children supported by SNAP were mostly non-Hispanic White (41.3%) and non-Hispanic Black (34.5%). Lastly children supported by neither SNAP nor WIC were mostly non-Hispanic White (63.7%). The percentage of individuals with an annual household income of less than $20,000 was much lower among those receiving WIC only (17.9%) and those receiving neither benefit (10.0%), as compared to those receiving both benefits (63.1%) and those receiving SNAP only (53.4%).

Aim 1: WIC/SNAP Outcome Trends

The data was first examined to quantify associations between WIC/SNAP status with obesity and dietary outcomes.

Figure 1 shows that unadjusted BMI percentile means were not statistically significantly different with WIC/SNAP status. Figure 1 also shows that children supported by WIC and/or SNAP had slightly higher adjusted mean BMI percentiles compared to children supported by neither program. However, these adjusted results

were not statistically significant. The results displayed in figure 1 failed to show that WIC/SNAP status significantly correlates with BMI.

Next, WIC/SNAP status was compared to diet quality. Figures 2-6 shows that children on WIC and/or SNAP had significantly higher unadjusted means for most dietary measures compared to children on neither WIC nor SNAP. The adjusted results in Figures 2-7 show that the only significant findings were that WIC participation only was associated with higher intakes of carbohydrates and sugar compared to children on neither program. Figure 2 shows no significant differences for total calories by WIC/SNAP status. Figure 3 shows no significant differences for protein intake by WIC/SNAP status. Figure 4 shows no significant differences for the total fat by WIC/SNAP status. Figure 5 shows that children supported by WIC only (224 g; 95% CI: 221, 262) had significantly higher adjusted carbohydrate intake compared to children supported by neither WIC nor SNAP (208 g; 95% CI: 195, 221). Figure 6 shows no significant differences for the saturated fat by WIC/SNAP status. Figure 7 shows that children supported by WIC only (133 g; 95% CI: 121, 145) had significantly higher adjusted sugar intake compared to children supported by neither WIC nor SNAP (112 g; 95% CI: 105, 119) and children supported by SNAP only (119 g; 95% CI: 110, 129) and children supported by both WIC and SNAP (113 g; 95% CI: 107, 119).

Aim 2a: Correlation between WIC/SNAP and Healthy Food Affordability

Table 2 compares WIC/SNAP usage to healthy food affordability with participants of neither program used as the reference group. Adult caregivers with children on WIC and SNAP were significantly less likely to report being able to afford healthy foods

compared to adult caregivers of children not on WIC or SNAP (OR: 0.51; 95% CI: 0.34, 0.77). Adult caregivers with children on WIC only were significantly less likely to report being able to afford healthy foods compared to adult caregivers of children not on WIC or SNAP (OR: 0.52; 95% CI: 0.28, 0.96). Adult caregivers with children on WIC and SNAP were significantly less likely to report being able to afford healthy foods compared to adult caregivers of children not on WIC or SNAP (OR: 0.60; 95% CI: 0.38, 0.96).

Aim 2b: Effect of Healthy Food Affordability on BMI Percentile

Children with less healthy food affordability had, on average, lower, but not statistically significantly lower, BMI percentiles (table 3). The results did not change after adjusting for WIC/SNAP status, race, household size and education level (table 4).

Aim 2c: Effect of Healthy Food Affordability on Diet

Using the unadjusted model in table 5, we not did find a statistically significant relationship between healthy food affordability status and any dietary measure. Adjusted linear regression models also found no association between the diet measures and healthy food affordability (table 6).

Chapter 5: Discussion

Summary of Results

The findings in this research did not support our original hypotheses. We found no correlation between WIC/SNAP status and BMI percentile. Children supported by WIC only were shown to have higher intakes of carbohydrates and sugar compared to children supported by neither WIC nor SNAP. WIC and/or SNAP usage was found to correlate to lower parent-reported healthy food affordability compared to participants of neither WIC nor SNAP. However, low healthy food affordability did not correlate with significantly higher BMI percentile or significantly higher levels of any the dietary measures.

Significance

Aim 1 found that children supported by WIC only had worse diets than children supported by neither WIC nor SNAP. This contrasts with previous research by Siega-Riz et al. which showed WIC to have a beneficial effect on overnutrition.[2] However, a more recent study consistent with our findings, Deming et al. found that WIC toddlers consumed more “sweets” ($P<0.05$) and more sugar-sweetened beverages ($P<0.01$) compared to non-participants.[17] The benefits of WIC cannot logically be explained as causing overnutrition. WIC children may have a health disparity because families with children at risk overnutrition are more drawn to WIC for its dietary counseling. This would expose the weakness of cross sectional studies. A longitudinal study of children supported by WIC is needed to determine the effect of WIC participation on diet over time. Despite the overnutriton found in WIC only children, there was no difference in BMI

percentile. However, these eating practices are still of concern because they may lead to obesity later in life.

Aim 2 showed that affordability of healthy foods was not found to be a significant risk factor for obesity and overnutrition among children supported by WIC and/or SNAP. Healthy foods may be available at cheap enough prices to prevent affordability from effecting diet quality despite what some parents might think. This would suggest that interventions do not need to target affordability but perhaps intervention should focus on reducing fat in cooking or education on portion control. Other risk factors for obesity and overnutrition in WIC/SNAP children need to be studied to determine which are significant and should be targeted for intervention. Possible causes to investigate may include lack of knowledge healthy cooking practices or ability to estimate calories in a meal eating and this information can be used to create informed WIC and/or SNAP intervention programs.

Strengths and Weaknesses

This study had some significant strengths. NHANES provided a nationally representative study sample with reliable data collected recently, 2003-2010. The use of many dietary measures allowed for a broad look at the diet quality of the subjects. The BMI percentiles using the 2000 CDC growth curve took into account child age, height, and gender as an assessment for obesity. Various covariates were assessed as confounders and controlled for in adjusted analysis.

The research also had some weaknesses. There are concerns about the assessment of SNAP and WIC enrollment. SNAP was only assessed at the household

level so it was difficult to tell if this money goes toward the child's nutrition. Both WIC and SNAP were also assessed by asking if either was used in the last 12 months, this did not examine the duration or value of the benefits received which may create random error. The healthy food affordability variable may not accurately reflect a true cost barrier to healthy foods because it is subjectively reported by the parents. Income was difficult to assess as a confounder because NHANES assessed income using overlapping answer choices (such as <$4,999 and <$20,000). The 24-hour dietary recalls may not be representative of a child's overall diet because they only capture a sample of the child's diet as remembered by a parent, and may miss episodically-consumed foods. Absolute macronutrient intakes are also difficult to get correct from a dietary recall. This is because portion sizes and macronutrient density have very greatly between foods creating high random error. As previously discussed, this cross-sectional study did not allow for examination of change over time. Childhood BMI percentile may not indicate poor health behaviors and future obesity because the behaviors could need to occur over more time to significantly impact BMI. Despite the weaknesses, this research highlights the need for further work to be done on childhood obesity prevention.

Conclusion

The lack of any benefit from WIC use only compared to SNAP use only in this research may suggest that the current WIC practices are not successful. However further research would need have similar findings to prove that the WIC program needs changes. Further research must uncover more about what does contribute to obesity

among children supported by WIC and/or SNAP. Given the large number of children on WIC and SNAP, the programs need to incorporate more educational information on preventing childhood obesity. Although obesity was not associated with WIC/SNAP use in this research, childhood obesity remains a problem. SNAP and WIC are meant to improve health and have previously been used to target childhood obesity.[18,19] However, research is needed to inform policy makers about what risk factors for obesity are more important targets. This research suggests that the affordability of healthy food is not one of these risk factors because it did not correlate with any negative health outcomes.

Overall the fight against childhood obesity in complex and difficult. However, it is important to significantly improve the health of the United States.

Tables

Table 1. Demographics percentages stratified by WIC/SNAP status of children between the ages of 2 and 4 in NHANES years 2003 to 2010. (n=1714)*

Variable	Subcategory	WIC/SNAP Status				
		Both (n=627)	**WIC only (n=282)**	**SNAP only (n=282)**	**Neither (n=523)**	**Total (n=1714)**
Total (%)		29.2	14.5	14.8	41.5	100
Age, yrs. (%)	2	39.7	37.0	25.0	32.5	34.1
	3	29.4	30.3	40.2	31.9	32.2
	4	30.9	32.8	34.7	35.6	33.7
Gender (%)	Male	49.6	51.6	50.4	52.1	51.0
	Female	50.4	48.4	49.6	47.9	49.0
Race/Ethnicity (%)	Mexican American	27.1	34.7	9.4	12.8	19.6
	Other Hispanic	10.6	4.8	8.0	5.1	7.1
	Non-Hispanic White	29.3	43.6	41.3	63.7	47.4
	Non-Hispanic Black	25.4	13.8	34.5	9.7	18.5
	Other (Including Multi Racial)	7.7	3.1	6.9	8.7	7.3
Household Size (%)	2	2.9	2.2	5.6	3.3	3.4
	3	16.5	10.8	23.2	21.4	18.8
	4	27.8	26.0	27.7	33.6	29.9
	5	16.8	25.9	17.3	24.1	21.2
	6	13.9	15.0	14.1	10.5	12.7
	7+	22.1	19.7	12.1	6.9	14.0
Annual Household Income (%) **	Less than 20,000	63.1	17.9	53.4	10.0	33.0
	20,000 Plus	36.9	82.1	46.6	90.0	67.0
Highest Household Education (%) ***	Less than 9th Grade	11.0	10.9	7.2	2.3	6.7
	More than 9th Grade with no Diploma	27.8	21.1	27.2	7.0	18.0
	High School Diploma or GED	29.1	27.7	27.6	20.4	25.0
	Some College or AA	28.2	32.6	34.9	30.6	30.8
	College Degree	4.0	7.6	3.1	39.8	19.4
Healthy Food Affordability (%)	Less Affordability of Healthy Food	32.3	29.0	24.6	10.7	21.7
	Greater Affordability of Healthy Food	67.7	71.0	75.4	89.3	78.3

*Percentages are weighted for a US-representative population.
**73 subjects chose not to report annual household income.
***43 subjects did not report highest household education.

Table 2. Adjusted odds ratios for the association between WIC and/or SNAP enrollment and healthy food affordability among children between the ages of 2 and 4 in NHANES 2003-2010.* ** (n=1671)***

WIC or SNAP Status	**Odds Ratio**	**95% Confidence Interval**	
		Lower Limit	Upper Limit
WIC and SNAP	0.51	0.34	0.77
WIC Only	0.52	0.28	0.96
SNAP Only	0.60	0.38	0.96

*Statistics are weighted based on NHANES weights for a representative population and controlled for household size, highest parent education and race.
**Reference group for odds ratio calculations are subjects not participating in either WIC or SNAP.
***Only 1671 subjects were used because some were excluded for missing covariates.

Table 3. Unadjusted BMI percentile means stratified by healthy food affordability status among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1714)

Healthy Food Affordability Status	**Mean BMI Percentile**	**95% Confidence Interval**	
		Lower Limit	Upper Limit
Less Healthy Food Affordability	58.0	54.7	61.3
Greater Healthy Food Affordability	59.0	56.6	61.4

*Means are weighted based on NHANES weights for a representative population.

Table 4. Adjusted linear regression analysis for BMI percentile and healthy food affordability status of children among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1671) **

Healthy Food Affordability Status	**Mean BMI Percentile**	**95% Confidence Interval**	
		Lower Limit	Upper Limit
Less Healthy Food Affordability	58.7	55.3	62.1
Greater Healthy Food Affordability	59.8	56.8	62.9

*Estimates are weighted based on NHANES weights for a representative population and controlled for WICSNAP status, race, household size and highest household education level.
**Only 1671 subjects were used because some were excluded for missing covariates.

Table 5. Unadjusted diet means stratified by healthy food affordability among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1714)

Diet Measure	Statistic	Less Healthy Food Affordability	Greater Healthy Food Affordability
Energy (kcal)	Mean	1613	1569
	95% CI	(1542, 1683)	(1530, 1607)
Protein (gm)	Mean	56.2	54.7
	95% CI	(53.5, 58.8)	(52.6, 56.7)
Carbohydrates (gm)	Mean	220	216
	95% CI	(211, 230)	(210, 222)
Total Fat (gm)	Mean	58.6	56.0
	95% CI	(55.2, 61.9)	(54.0, 57.9)
Total Saturated Fatty Acids (gm)	Mean	21.3	20.6
	95% CI	(20.1, 22.5)	(19.8, 21.4)
Total Sugars (gm)	Mean	119	117
	95% CI	(113, 125)	(113, 121)

*Statistics are weighted based on NHANES weights for a representative population.

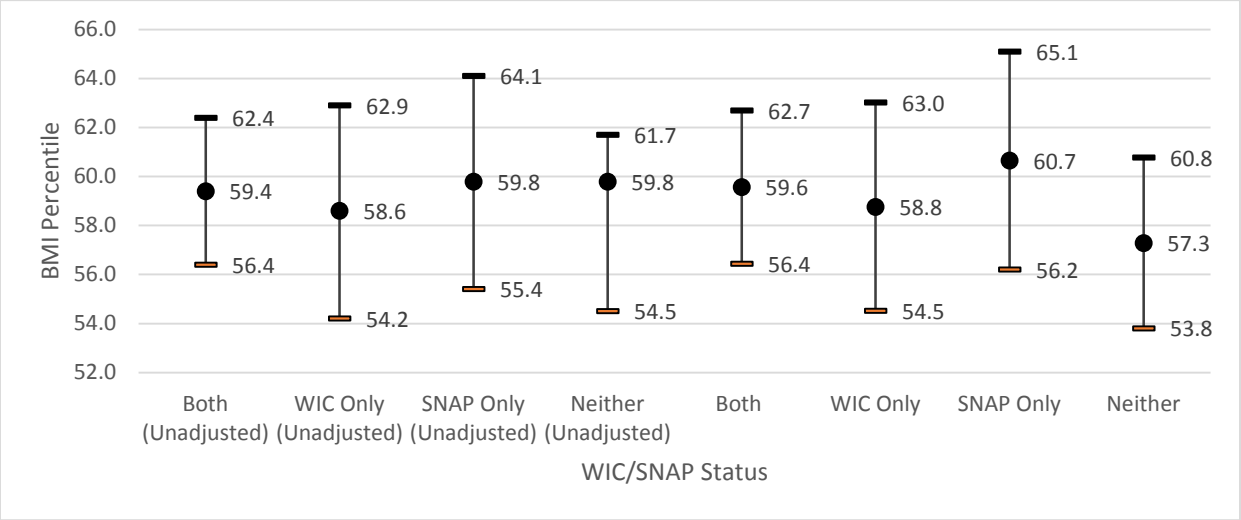
Table 6. Adjusted linear regression analysis for diet measures and healthy food affordability status of children among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=**)

Diet Measure	Covariates Controlled for	Statistic	Less Healthy Food Affordability	Greater Healthy Food Affordability
Energy (kcal)	Education, Diet Day, WIC/SNAP status	Mean	1603	1595
		95% CI	(1526, 1681)	(1548, 1642)
Protein (gm)	Age, Race, Diet Day, WIC/SNAP status	Mean	56.6	56.7
		95% CI	(53.5, 59.8)	(54.3, 59.0)
Carbohydrates (gm)	Education, Diet Day, WIC/SNAP status	Mean	221	221
		95% CI	(211, 232)	(214, 229)
Total Fat (gm)	Education, Diet Day, WIC/SNAP status	Mean	57.3	56.4
		95% CI	(53.4, 61.2)	(54.2, 58.5)
Total Saturated Fatty Acids (gm)	Education, Household size, Race, Diet Day, WIC/SNAP status	Mean	20.9	20.6
		95% CI	(19.4, 22.4)	(19.5, 21.7)
Total Sugars (gm)	Education, Diet Day, WIC/SNAP status	Mean	119	119
		95% CI	(113, 126)	(114, 123)

*Estimates are weighted based on NHANES weights for a representative population.
**Protein measure had a sample size of 1714 but other tests had a smaller sample size of 1671 because subjects missing education covariate were excluded.

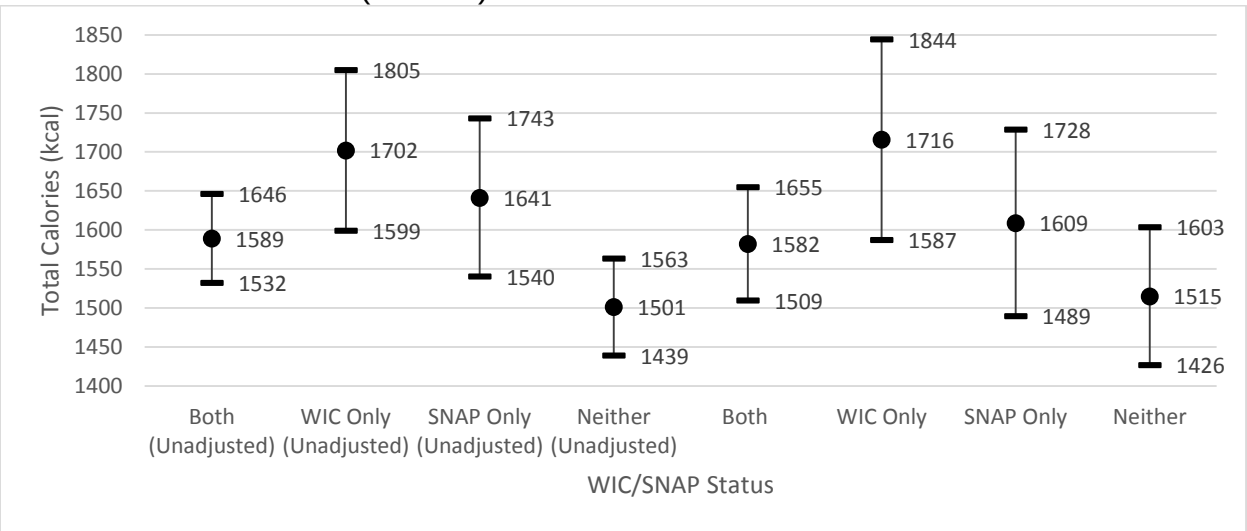
Figures

Figure 1. Adjusted and unadjusted BMI percentile means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1671)**



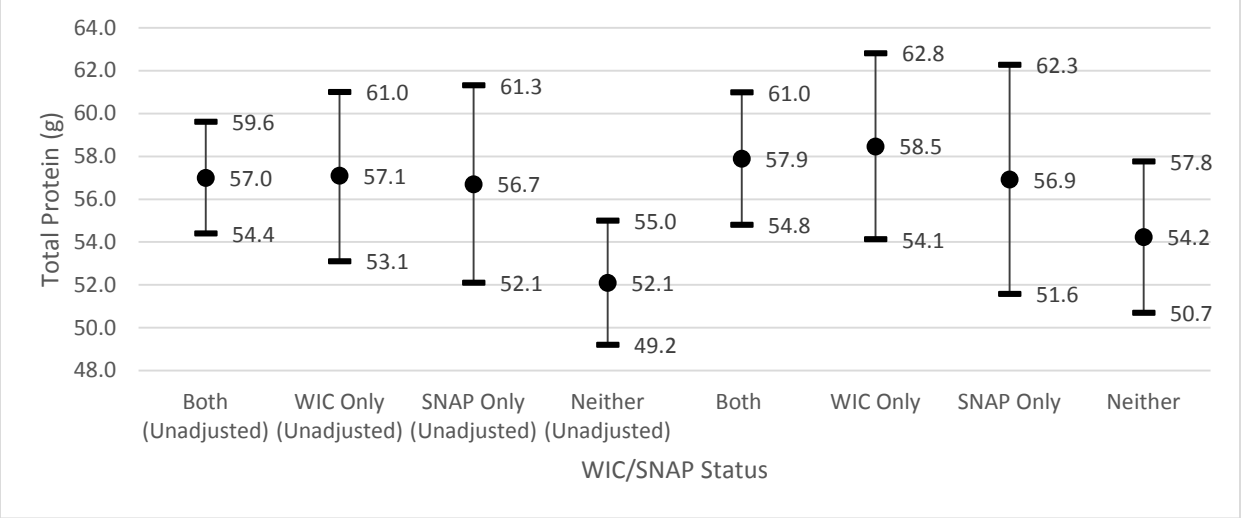
*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for race, education, household size and age.
**Only 1671 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

Figure 2. Unadjusted and adjusted total calorie means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



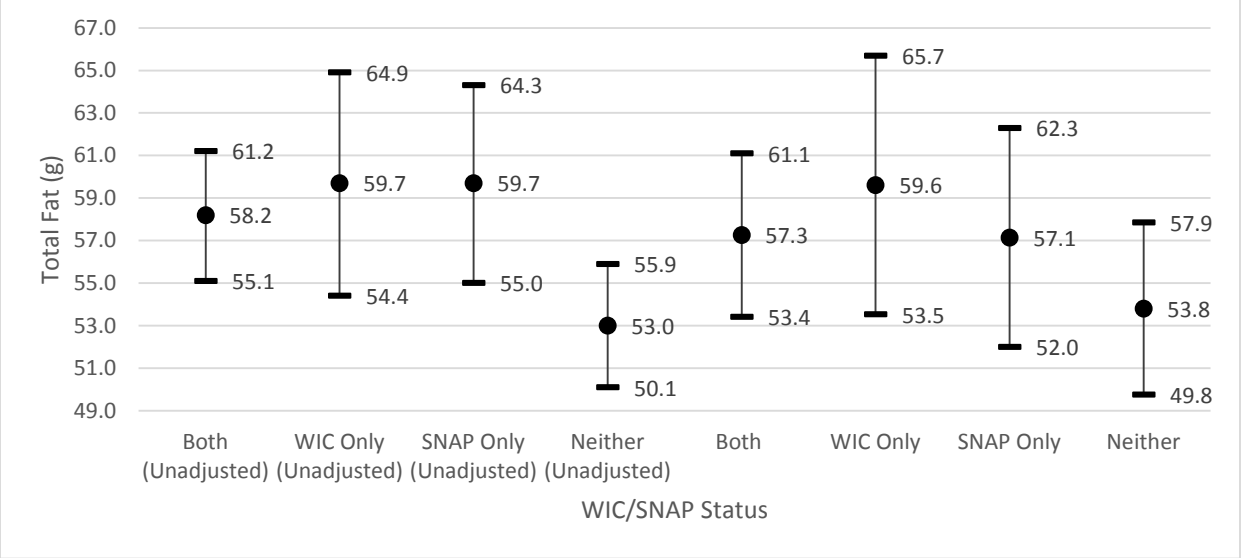
*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, race, education, income and age.
**Only 1606 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

Figure 3. Unadjusted and adjusted total protein means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



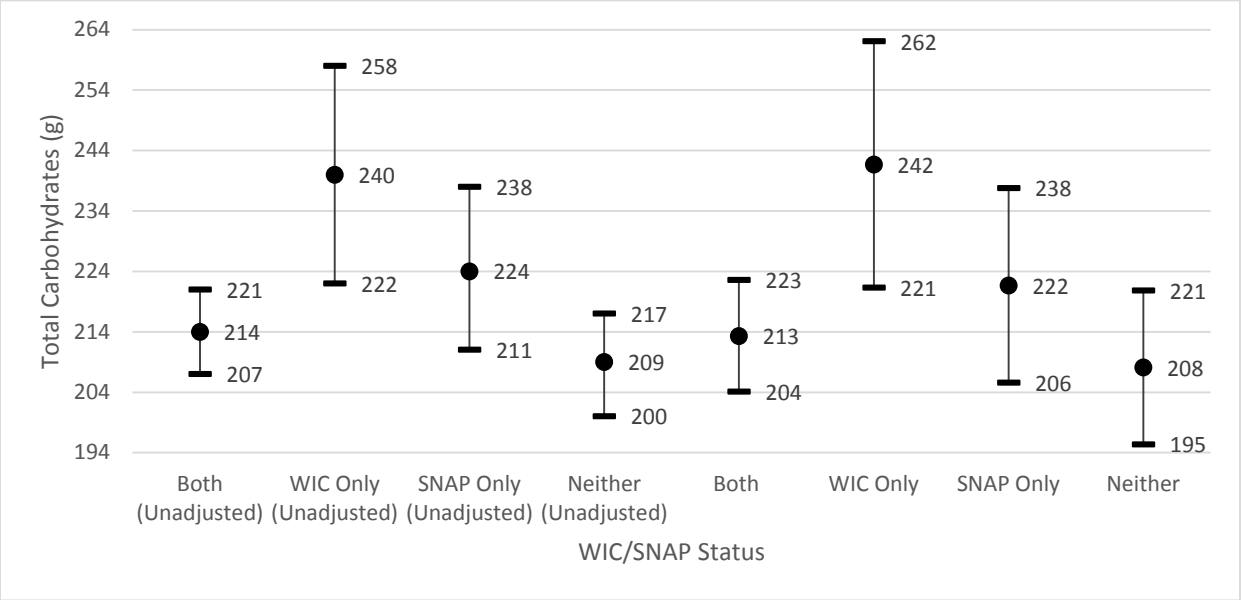
*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, race, education, income and household size.
**Only 1606 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

Figure 4. Unadjusted and adjusted total fat means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



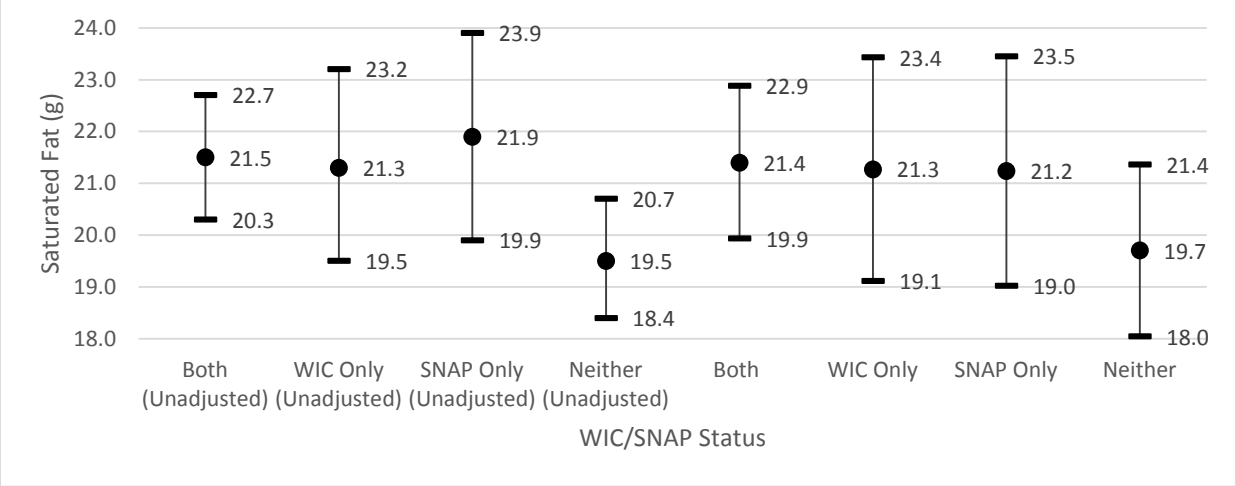
*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, age, race, education, income and household size.
**Only 1606 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

Figure 5. Unadjusted and adjusted total carbohydrate means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



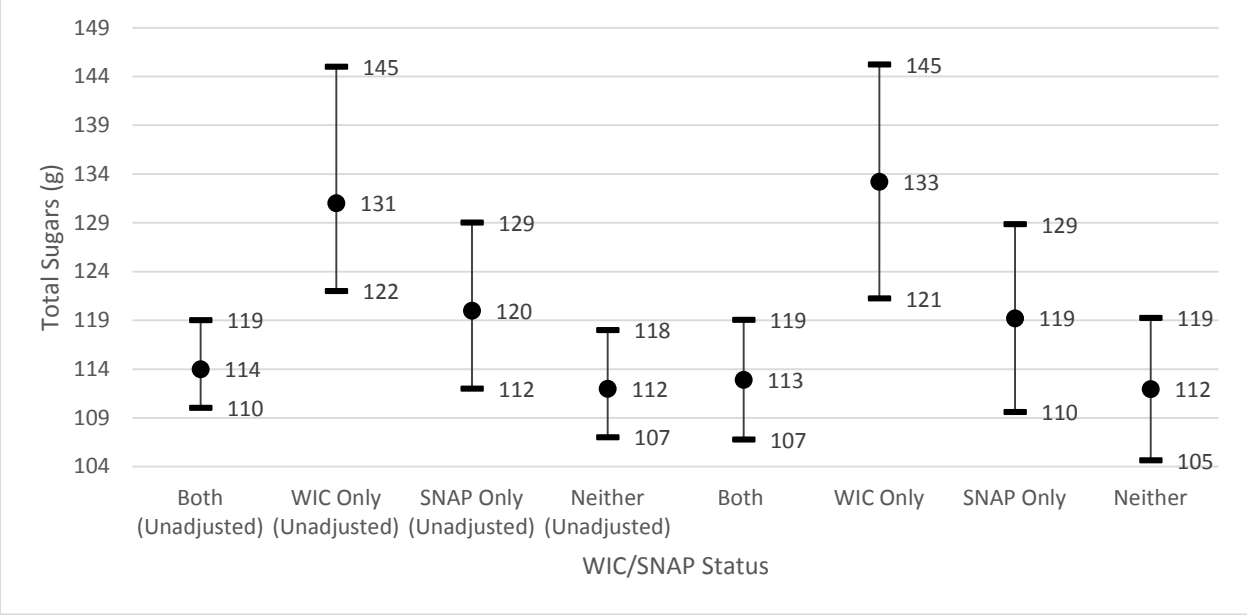
*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, age, race, education, income and household size.
**Only 1606 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

Figure 6. Unadjusted and adjusted saturated fat means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, age, race, education, income and household size.
**Only 1606 subjects were used for adjusted subjects because some subjects were excluded for missing covariates.

Figure 7. Unadjusted and adjusted total sugar means and 95% confidence intervals stratified by WIC and/or SNAP enrollment among children between the ages of 2 and 4 in NHANES 2003-2010.* (n=1606)**



*Statistics are weighted based on NHANES weights for a representative population and adjusted statistics were controlled for diet day, race, education, income and household size.

**Only 1606 subjects were used for adjusted statistics because some subjects were excluded for missing covariates.

References

1. Leung, C., Blumentha, S., Hoffnagle, E., Jensen, H., Foerster, S., Nestle, M., ... Willett, W. (2013). Associations of Food Stamp Participation With Dietary Quality and Obesity in Children. Pediatrics, 131(3), 463-472. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/23439902

2. Siega-Riz, A. M. (02/2004). The journal of pediatrics: The effect of participation in the WIC program on preschoolers' dietsC.V. Mosby. doi:10.1016/j.jpeds.2003.10.052 http://www.ncbi.nlm.nih.gov/pubmed/14760267

3. Facts About SNAP. (2014, November 6). Retrieved March 25, 2015, from http://www.fns.usda.gov/snap/facts-about-snap

4. About WIC. (2014, March 10). Retrieved March 25, 2015, from http://www.fns.usda.gov/wic/about-wic

5. WIC -- The Special Supplemental Nutrition Program for Women, Infants and Children. (2014, April 1). Retrieved March 25, 2015, from http://www.fns.usda.gov/sites/default/files/WIC-Fact-Sheet.pdf

6. WOMEN, INFANTS, AND CHILDREN (WIC) PARTICIPANT AND PROGRAM CHARACTERISTICS 2012: SUMMARY. (2013, December 1). Retrieved March 25, 2015, from http://www.fns.usda.gov/sites/default/files/WICPC2012_Summary.pdf

7. SNAP: Frequently Asked Questions. (n.d.). Retrieved March 25, 2015, from http://www.snaptohealth.org/snap/snap-frequently-asked-questions/

8. Pérez-Escamilla, R. (11/2000). The journal of nutrition: Food stamps are associated with food security and dietary intake of inner-city preschoolers from hartford,

connecticut Wistar Institute of Anatomy and Biology http://www.ncbi.nlm.nih.gov/pubmed/11053511

9. Metallinos-Katsaras, E. (07/2011). Maternal and child health journal: A longitudinal study of WIC participation on household food insecurity Springer. doi:10.1007/s10995-010-0616-5 http://www.ncbi.nlm.nih.gov/pubmed/20455015
10. DeMartini, T. L. (12/2013). Journal of community health: Food insecure families: Description of access and barriers to food from one pediatric primary care center Springer. doi:10.1007/s10900-013-9731-8http://www.ncbi.nlm.nih.gov/pubmed/23852328
11. Haynes-Maslow, L. (2013). Preventing chronic disease: A qualitative study of perceived barriers to fruit and vegetable consumption among low-income populations, north carolina, 2011 U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center. doi:10.5888/pcd10.120206http://www.ncbi.nlm.nih.gov/pubmed/23489639
12. Childhood Overweight. (2014, May 1). Retrieved March 25, 2015, from http://www.obesity.org/resources-for/childhood-overweight.htm
13. About the National Health and Nutrition Examination Survey. (2014, February 3). Retrieved March 25, 2015, from http://www.cdc.gov/nchs/nhanes/about_nhanes.htm
14. Key Concepts About NHANES Survey Design. (n.d.). Retrieved March 25, 2015, from http://www.cdc.gov/nchs/tutorials/nhanes/SurveyDesign/SampleDesign/Info1.htm

15. Anthropometry Procedures Manual. (2007, January 1). Retrieved March 25, 2015, from http://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/manual_an.pdf

16. Task 2: Key Concepts About NHANES Dietary Data Collection. (n.d.). Retrieved March 25, 2015, from http://www.cdc.gov/nchs/tutorials/dietary/SurveyOrientation/DietaryDataOverview/Info2.htm

17. Deming, D. M. (05/2014). Journal of nutrition education and behavior: Infant feeding practices and food consumption patterns of children participating in WIC BC Decker. doi:10.1016/j.jneb.2014.02.020 http://www.ncbi.nlm.nih.gov/pubmed/24809994

18. Whaley, S. E. (05/2010). Journal of nutrition education and behavior: A WIC-based intervention to prevent early childhood overweight BC Decker. doi:10.1016/j.jneb.2010.02.010 http://www.ncbi.nlm.nih.gov/pubmed/20399409

19. Leung, C. W. (01/2013). Journal of the academy of nutrition and dietetics: A qualitative study of diverse experts' views about barriers and strategies to improve the diets and health of supplemental nutrition assistance program (SNAP) beneficiaries Elsevier. doi:10.1016/j.jand.2012.09.01 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3548568/